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Description of the external anatomy of the marine snail *Cystiscus obesulus* May (Mollusca: Gastropoda: Cystiscidae)

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Abstract
Recent observations of living specimens of the marine snail *Cystiscus obesulus* (May 1919) from Victorian waters have enabled a report on the external morphology of this species. The external anatomy helps to confirm the family placement, and the distinctive colour pattern separates it from other closely related species. A brief review of other published biological and taxonomic information relating to this species is also provided. (*The Victorian Naturalist*, **121** (4), 2004, 163-168).

Introduction

On Sunday 26 January 2003, the Marine Research Group (MRG) of the Field Naturalists Club of Victoria undertook a field trip to Mushroom Reef, Flinders. There, shortly after noon, approximately half a dozen living specimens of a minute, strikingly patterned marginelliform gastropod were found by sieving through lower littoral pools containing mainly the seagrass *Amphibolis antarctica* and also some scattered brown algae. Two specimens were legally collected under MRG permits held from Parks Victoria for identification and further study. The animals were subsequently identified as *Cystiscus obesulus* (May 1919).

A further specimen of this mollusc was encountered during a personal trip to Cleeland Bight, Phillip Island on Tuesday 8 April 2003. A sieve was run through a bed of *Zostera* sp. eel-grass, unknowingly capturing a single, minute individual of *Cystiscus obesulus*. It was unexpectedly discovered the following day after a microscopic examination of the contents of the collecting vial.

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These sightings provided good opportunities to observe and report on the living animal.

Methods

On each occasion, the animals were kept alive in seawater and placed in a shallow dish for study under a low power stereomicroscope at magnifications up to ×45, using fluorescent lighting. Notes and drawings were made at the microscope. On completion of each respective study, the animals were photographed and preserved in 70% ethanol. They have been formally lodged in Museum Victoria - registered numbers F100,027 (Mushroom Reef specimens) and F100,028 (Cleeland Bight specimen).

Observations

The shells from the Flinders specimens were approximately 2.0 mm in length, whilst the shell of the Cleeland Bight specimen was approximately 1.0 mm long. All shells were smooth, translucent, short spired and relatively broad, with a blunt apex and a long, narrow aperture. May (1919) described six columellar plications (the first or most anterior being the

Fig. 1. *Cystiscus obesulus*: specimen from Cleeland Bight, Phillip Island, Victoria. Scale: 0.25mm. (Drawing: P. Vafiadis).

strongest, and the last four being very minute) and about nine minute denticulations on the middle portion of the outer lip. These denticulations were faintly visible in the Flinders specimens, but the outer lip of the Cleeland Bight specimen lacked any visible denticulations. The incompletely retracted foot in the preserved Flinders specimens partially obscured the columellar plications, but these were readily visible in the Cleeland Bight specimen, the shell of which is shown in Fig.1.

The animals were all active and distinctively pigmented (Figs. 2 and 3). The mantle, visible beneath the thin, translucent shell, showed patches of yellow-orange lined by a brown-black rim; these patches were separated from each other by a cream-coloured 'background'. This produced a mosaic appearance somewhat reminiscent of a giraffe's spots. The patches were present on early whorls, as well as on the body whorl. The spacing between patches was reasonably uniform, and their edges were approximately parallel to those of adjacent patches. May (1919: 58) described these features as follows: '... the very peculiar animal, ... showing through the translucent shell, exhibits a bright orange colour curiously netted with white lines, each bordered with black; empty shells show no traces of this peculiar ornamentation, which must belong to the animal.' Although the patterning of the Cleeland Bight animal was identical to those from Flinders, its colours were not as vivid. May (1919) made no further comment on the anatomy of this species.

The head of *C. obesulus* was notable (Figs. 4a and 4b). It was moderately flattened in the dorso-ventral plane, and bore prominent, round, bright red eyes laterally at the bases of what are here called 'cephalic tentacles' (see also the 'Anatomical Discussion' section below). The eyes were clearly visible from both the dorsal (Figs. 2 and 4a) and ventral (Figs. 3, 4b and 4c) aspects of the head. The 'cephalic tentacles' were semi-translucent, relatively short, bluntly rounded at their ends, and also moderately flattened dorso-ventrally. Where they touched in the dorsal midline, a full-thickness midline cleft or slit extended posteriorly to end just anterior to the eyes (Fig. 4a). The minuteness of the Cleeland Bight specimen made the precise location of the posterior aspect of this cleft more difficult but, as with the Flinders specimens, it seemed to terminate at around the level of the eyes. Ventrally, the 'cephalic tentacles' were united across their proximal halves by a membrane that was continuous with them, forming the floor of a cavity that was the entrance to the mouth (Fig. 4a). The 'cephalic tentacles' in the Cleeland Bight specimen obscured the anterior aspect of the ventral membrane when the animal was viewed dorsally.

The head was strikingly coloured with a bright red hue on both its dorsal and ventral surfaces. This colouration extended across the width of the head posterior to the eyes, and narrowed more anteriorly to occupy the central region of the head, largely sparing the 'cephalic tentacles'. This red colouration was sparsely stippled with fine black spots (the latter not prominent in the Cleeland Bight specimen). The 'cephalic tentacles' were blotched with small patches of white-cream. The animals lacked a siphon and no other accessory structures were seen on any of them. The head always protruded well in front of the anterior foot. The union between the anterior foot and the visceral mass was posterior to the eyes (Fig. 5) but could not be well seen.

The Flinders specimens often crawled up

Fig. 2. *Cystiscus obesulus*; specimen 1, from Flinders, Victoria.

Fig. 3. *Cystiscus obesulus*; specimen 2 (ventral view), from Flinders, Victoria.

the sides of the dish and inverted themselves upon the surface of the water, where, assisted by surface tension, they would 'crawl' with the foot fully extended. This allowed the ventral surface of the foot (the sole) to be well observed. (The Cleeland Bight specimen did not do this and would not allow itself to be turned to view the sole). The foot was long and relatively narrow, approximately one and a third times the length of the shell, and at the anterior end was expanded bilaterally to form two distinct rounded lobes (Figs. 3 and 4c). The middle two thirds of the sole bore a deep, midline, longitudinal cleft, which became more shallow as it extended to the anterior and posterior ends (Figs. 3 and 4c). This represented a pedal mucous gland, producing sticky, invisible mucous threads that adhered to instruments used to position the animals during observations. The sole was semi-opaque white, finely and sparsely stippled with very fine black dots. The upper surface of the foot was also a semi-opaque white, bearing blotches of whitish cream in the midline posteriorly, and to a degree anteriorly. Some reddish colouration was evident at the anterior-most margin and also on the lateral aspects posteriorly. During crawling, the anterior

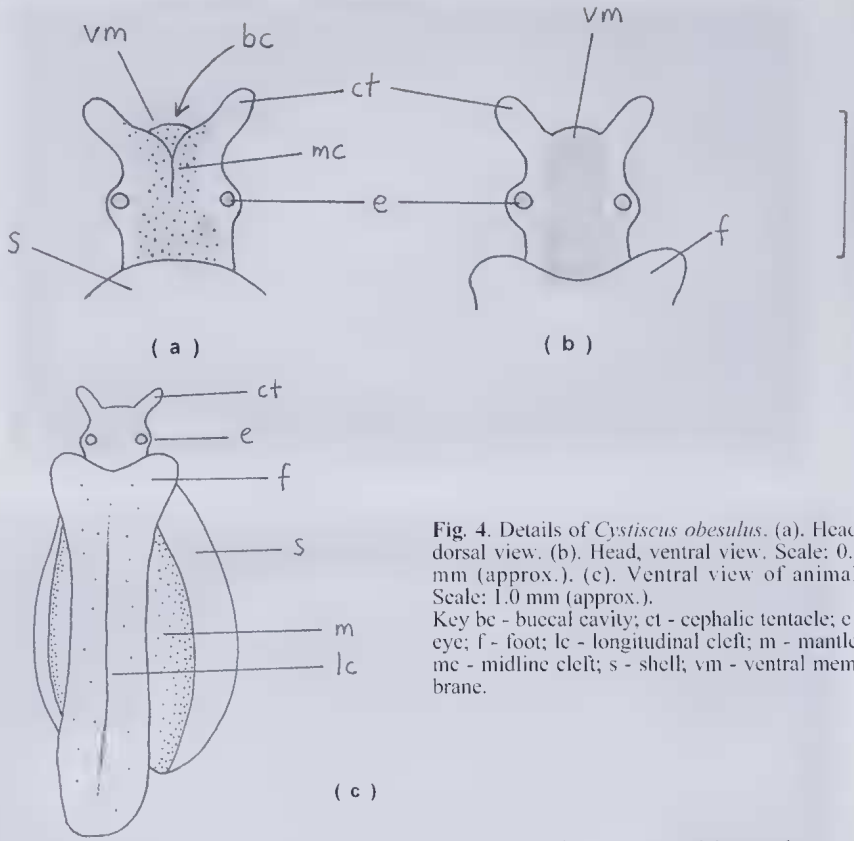

Fig. 4. Details of *Cystiscus obesulus*. (a). Head, dorsal view. (b). Head, ventral view. Scale: 0.5 mm (approx.). (c). Ventral view of animal. Scale: 1.0 mm (approx.).
Key bc - buccal cavity; ct - cephalic tentacle; e - eye; f - foot; lc - longitudinal cleft; m - mantle; mc - midline cleft; s - shell; vm - ventral membrane.

end of the foot was usually level with or slightly behind the anterior shell margin in one of the Flinders animals, whilst in the other it was in front of the shell margin and thus readily visible (Fig. 2). During observation in all individuals, the mantle did not extend beyond the base of the shell. It was translucent and stippled with very fine, black spots (the latter again not prominent in the Cleeland Bight specimen). These spots were most densely concentrated on its outer edges (Fig. 4c).

The animals crawled with a smooth, gliding motion. They were all active and could not be coaxed back into their shells. No operculum was apparent either before or after fixing.

Anatomical discussion

In a detailed review of marginelliform gastropods, Coovert and Coovert (1995) recognised the Cystiscidae as a separate family from the Marginellidae, based on characters of external and internal anatomy, and also on shell morphology. Cystiscidae shells lack a thickened outer lip, have discontinuous or internally reduced columellar plications (due to a degree of subsequent internal shell resorption), and most genera lack a distinct siphonal notch; these features are enough to separate the Cystiscidae from the Marginellidae (Coovert and Coovert 1995).

Anatomically, marginelliform gastropods have been divided into four external morphological types based mainly on features of the head and siphon (Coovert 1987; Coovert and Coovert 1995). In this classification the genus *Cystiscus* belongs to the Type 3 group, characterised by 'an elongate head that is longitudinally split dorsally, with the anterior end bifurcate. ... The siphon is either very short and not readily apparent, or completely absent. Eyes are located on the sides of the head, usually in

Fig. 5. *Cystiscus obesulus* (lateral view), from Flinders, Victoria.

a conspicuous bulge' (Coovert and Coovert 1995: 51). The emergence of this arrangement is interpreted as either a ventral fusion of the cephalic tentacles (causing a longitudinal dorsal cleft), or as a head lacking cephalic tentacles that has become split in its dorsal longitudinal aspect, but more anatomical study is needed to resolve this issue (Coovert and Coovert 1995). The remarkable head of *Cystiscus minutissimus* (Tenison Woods 1876) is figured by Murray (1970: 33, Fig. 1b.) and Coleman (2003) has photographed this species (p.37), as well as *Cystiscus cymbalum* (Tate 1878) (p. 37) and *Cystiscus angasi* (Crosse 1870) (p. 36). Burn and Hewish (unpubl.) deseribe the animal of the cystiscid *Gibberula subbulbosa* (Tate 1878).

When lacking the animal, the shells of *C. obesulus* and *C. angasi* are essentially indistinguishable; when alive, however, their distinctive colouration and patterns readily separate them (Burn 2003, pers. comm.; Hewish 2003, pers. comm.).

The radulae of the Cystiscidae differ from those of the Marginellidae in being longer and narrower, and exhibiting differences in their supporting structures (Coovert and Coovert 1995). Four types of cystiscid radulae and five types of marginellid radulae are described and figured in Coovert and Coovert (1995). The foregut also has taxonomic importance and its features are discussed in some detail by Coovert and Coovert (1995) for the species in which it is known.

As at 1995, internal anatomical information (excluding radular studies) was available for only three species in the Cystiscidae and none for the genus *Cystiscus* (Coovert and Coovert 1995). The radula in *Cystiscus* (a 'Type 2 radula') is long, narrow, and uniserial, with the teeth bearing 5-15 cusps on their cutting edges (Coovert and Coovert 1995).

Murray (1970) made valuable anatomical and life-cycle observations of *C. minutissimus* (Tenison Woods 1876) over many months by maintaining it and its host food source, the bryozoan *Amathia biseriata* (Krauss 1837) in glass dishes of seawater at average temperatures of 15.5 degrees celsius. *C. minutissimus* is a uniform orange-yellow colour with a dorsally bifurcate head that lacks a siphon (Murray 1970). The propodium is bifurcate, and the foot lacks an operculum (Murray 1970), consistent with observations of *C. obesulus*. Apart from the presence of a penis in male animals, Murray (1970) noted that *C. minutissimus* exhibits no other degree of external sexual dimorphism. Murray (1970) observed and described the mating process in *C. minutissimus*, and noted that every two days or so, females laid on the host bryozoan a single, ovoid-elongate egg capsule containing a single red-yolked egg (see Murray 1970, Figs. 1a, e-f). Six to seven weeks after laying, a crawling juvenile emerged from the capsule to settle directly onto the host bryozoan.

Based on shell and anatomical character-

istics, Coovert and Coovert (1995) suggest that the Cystiscidae are more closely related to the Olividae than to the Marginellidae, and the Marginellidae themselves are more closely related to the Volutidae than to the Cystiscidae.

Conclusion

Micromolluses are readily overlooked because of their size, but they have much to offer in terms of their external beauty and scientific interest. As seen with *Cystiscus obesulus*, shell characters alone may be insufficient for identification without accompanying information on colouration, patterning and anatomy of the living animal. It is hoped that simple observations, as here with *C. obesulus*, will contribute to existing knowledge of these molluses.

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Mating behaviour, female aggression and infanticide in *Propallene saengeri* (Pycnogonida:Callipallenidae)

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Abstract

Courtship and female aggression were observed in *Propallene saengeri* Staples. Courtship was initiated by the female after the departure of juveniles from the male's ovigerous legs. Courtship consisted of dancelike movements of both male and female, followed by physical contact with the legs. Once courtship was initiated between the male and one female, a second female became interested in the pair and intervened. This resulted in an aggressive response from the first female that eventually resulted in combat between the two females and the eventual death of one of them. Infanticide was also observed after juveniles had left the male with one female attacking and killing a juvenile. (*The Victorian Naturalist* **121** (4), 2004, 168-171)

Introduction

Pycnogonids or sea spiders are a large group (1200+ species) of marine chelicerates with exclusively male parental care of the eggs and young. They have been overlooked as subjects for behavioural studies. The majority of the recent pycnogonid literature consists of species descriptions with very few papers published on any other aspects of pycnogonid biology. Pycnogonid mating behaviour is virtually unknown with only a few published observations on the actual coupling between the male and the female (Table 1). Our current knowledge of premating behaviour is incomplete at best and information on competition for mates is nonexistent. Based on the observations in Table 1, courtship and mating consists of the male approaching the female, male and female assuming a close pairing or pseudocopulatory position (Jarvis and King 1978) initi-

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